

The Refrigeration Treatment of Chronic Osteomyelitis

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SUMMARY

Systemic penicillin therapy plus refrigeration at the site of the lesion, with operation if necessary, was used in the treatment of chronic osteomyelitis.

Nine patients with disease of long standing were treated. For three, bed rest, chemotherapy and refrigeration were sufficient. Surgical treatment in addition was carried out in six cases. Operations consisted of unroofing the abscess cavity, multiple drilling for sieve-like perforation of the abscessed bone, and primary suture of the incision. Solutions of penicillin, 500 to 1,000 units per cubic centimeter, were used for local irrigation at the time of closure.

In all cases the lesions healed and there was no recurrence within a period of two years. The period of hospitalization did not exceed 14 days in any case.

Refrigeration of the infected area before and after operation reduced pain, swelling, infection and toxemia.

TEN years ago, with the widespread use of the sulfonamide drugs, the mortality rate of acute osteomyelitis fell sharply to approximately 4 per cent, and the morbidity of chronic osteomyelitis as a complication of other injuries became correspondingly low. Since then, with the use of penicillin, the mortality rate of acute and chronic osteomyelitis has approached zero. Yet the occasional case of chronic or recurrent osteomyelitis of many years' standing is still a difficult surgical problem. Occasionally a new case of acute osteomyelitis will become chronic and necessitate surgical treatment despite the best of medical management.

Patients with acute osteomyelitis can be divided into two groups. First, those with primary acute osteomyelitis of metastatic hematogenous type in which an acute lesion appears, usually in a long bone. Most such patients are children. Occasionally there is a history of trauma or of mild infection elsewhere in the body—an upper respiratory infection, pimple or boil, or a small open wound. Since the advent of penicillin therapy, the management of cases of this type has become fairly well standardized—complete bed rest, immobilization of the soft tissue and joints of the affected limb, administration of penicillin to a high blood level, and occasionally in addition a sulfonamide drug by mouth. The lesion usually disappears in three to ten days. The addition of local refrigeration therapy to the site of infection has been reported to materially reduce

the pain, local swelling, duration of symptoms, and length of hospitalization.² In a small number of cases a localized abscess will form, occasionally containing infected fluid, although frequently the fluid is sterile owing to chemotherapy; and in such cases surgical incision and drainage or aspiration will be necessary. The injection of a local solution of penicillin into the abscess or infected joint cavity will materially reduce the extent of the local infection.

The second group of patients are those with acute osteomyelitis following infection of a compound fracture or an operation on a bone or joint. Such cases are rarer than in previous years but they will still occur as long as people have compound fractures and as long as surgical operations are done on bones and joints. The local use of penicillin solution, 500 to 1,000 units per cc., in the irrigation of compound fracture wounds during debridement, or in orthopedic surgical wounds before closure, will greatly reduce the incidence of bone infection.

In a series of 276 cases, including both compound fractures and operations on the bones and joints, acute infection occurred in only one case in which local irrigation of penicillin solution was used. In that case, suppuration developed approximately six weeks after operation for spinal fusion. After removal of a single bone chip, which had become infected and formed a sequestrum, prompt healing occurred. In cases of this type, local refrigeration of the affected part will materially reduce the pain, swelling, and the incidence of wound and bone infections.

Schaubel⁹ reported the use of refrigeration after orthopedic operations in 345 cases. He stated that the amount of narcotic necessary to relieve pain was greatly reduced, and that there was less pain and discomfort, less swelling, less occasion for postoperative casts and dressings to be loosened, and fewer postoperative complications. Gilbert, Call, and Roose³ used refrigeration and penicillin not only for wounds of the extremities but also in cases of epidermophytosis and varicose ulcers with extremely good therapeutic effect.

CHRONIC OSTEOMYELITIS

The cases of chronic osteomyelitis reported upon in this presentation were of two classes:

1. Those in which the bone remained infected over a period of many years, with periodic acute flare-ups with pain, swelling, and occasional drainage or extrusion of a sequestrum.

2. More recent cases of chronic osteomyelitis, usually following infection of a wound or operative site.

The term "osteomyelitis" as here used conforms with the American usage of the word, by which is meant any infection of the bone and adjacent tissues. It would be more correct to use the term

"ostitis" as meaning acute or chronic infection of bone tissue. This is the general term which includes both the conditions known as "osteomyelitis," which means inflammation of the bone marrow, and "periostitis," which means the inflammation of the periosteum and infection of the external surface of the bone.

The new techniques for the management of cases of chronic osteomyelitis described here do not in any way supplant the previous principles. Rather, they supplement the principles of good operative treatment of disease of the bones. The techniques for successful management of a case of chronic osteomyelitis can be divided into five phases, several of which are carried on simultaneously:

1. *Rest and immobilization.* The famous English orthopedist, Hugh Owen Thomas, was the first to insist on absolute rest and immobilization in treatment of infection of bones and joints. He used bed rest and secured immobilization by carefully made braces, splints, and bandages. A student of his, John Ridlon of Chicago, was in turn the teacher of Orr, who introduced the plaster cast and infrequent dressing method of treating chronic osteomyelitis.⁸ Orr's method was further elaborated and applied in the Spanish civil war by Trueta.¹⁰ In Orr's and Trueta's experience, open drainage of the wound, packing with petrolatum gauze loosely, and immobilization with plaster of paris splints and casts prevented the inspread of infection and toxemia and reduced the amount of edema and swelling and the general toxic reaction of the patient. Although the author feels that plaster casts are not necessary, absolute bed rest, elevation of the infected extremity and immobilization of the joints by splints during the active stage of infection are recommended.

2. *Chemotherapy.* The Carrel-Dakin method of irrigation of osteomyelitis lesions by dilute chlorine solution, the maggot treatment, and the sulfonamide treatment have been discarded in favor of penicillin therapy. Penicillin should be given in adequate dosage and for several days after disappearance of the last clinical evidence of infection. Now that the more slowly absorbing suspensions and emulsions of penicillin are available, 300,000 or 400,000 units, given twice a day intramuscularly, is considered adequate. The penicillin is usually continued for five to twenty days from the beginning of treatment. For children under 12 years of age the dose is decreased in proportion. If the organism can be isolated by culture of the blood or material from local drainage or abscess, it should be tested to determine if it is penicillin-sensitive.

3. *Refrigeration.* Allen and Crossman¹ (cited by Matthews and Hutter⁷) first introduced refrigeration in surgical treatment ten years ago. The use of refrigeration to produce anesthesia and to reduce the amount of septicemia and infection and gangrene of the extremities is well known. In the South Pacific during the recent war it was found to be useful in controlling infections in battle wounds and infections of the extremities which were slow or

resistant to healing in the high temperatures of the tropics. In many cases of badly damaged and infected limbs, some with considerable circulatory impairment, this method was used. The local infection was reduced, the systemic reactions to the infections decreased, and the circulation restored in the limbs in many cases in which otherwise amputation would have been necessary.

Technique. A small lesion can be covered with one or two ice caps placed over a moist towel next to the skin. A very acute and large lesion can be covered with one or two layers of moist toweling, with crushed ice applied directly over the towel. This is kept constantly in place for from five to fourteen days, or until evidence of local infection and inflammation has subsided.

The rationale for the use of refrigeration in chronic osteomyelitis is as follows: Bacteria multiply rapidly at body temperatures or higher, but at greatly reduced rates at low temperatures. The human extremities can tolerate 57° F. applied to the toes and fingers, 36° to 38° F. applied to the calf and upper extremities, and 32° F. applied to the thigh. Thus the body tissues can be cooled to temperatures at which bacteria multiply slowly but the tissues are not injured. The general temperature of the body is also lowered to a slight degree by local refrigeration, a beneficial factor in cases in which the patient has fever from the systemic effect of the local osteomyelitis. At the site of infection, cooling of the tissues seems to reduce the multiplication of the bacteria and increase the effect of penicillin. The circulation of the blood brings a constantly replenished supply of leukocytes and a fresh supply of penicillin to combat the infection. As a result the osteomyelitic lesion becomes more localized and smaller each day, and the virulence and toxicity of the infection is greatly lessened.

Refrigeration is begun as soon as the diagnosis of osteomyelitis can be made. The ice is again applied above the surgical dressings after operation and refrigeration is continued for three to five days, or until the patient's temperature is normal and the wound appears to be healing well. The ice is removed once or twice during the day for an hour for observation of the character of the circulation in the limb and the extent of the infection. The temperature of the skin at the site of infection always is much higher than that of the skin in the surrounding area. If the skin over the lesion does not become warmer than that of the opposite normal limb when the pack has been removed for an hour, refrigeration is discontinued.

4. *Surgical drainage of the abscess and removal of sequestrum.* In many cases, rest and immobilization, chemotherapy, and refrigeration may cause the infection to subside or to disappear completely. In other cases an abscess will form and become localized and fluctuant under the skin. In that event, all that is necessary is a short incision or a needle aspiration to remove the accumulated fluid. Very often cultures of this fluid will be sterile and patho-

logical examination will show only tissue necrosis and phagocytosis. In a few cases a definite sequestrum will form. This can be removed at the time the abscess is drained, and healing then usually is rapid and spontaneous.

5. *Surgical obliteration of the abscess cavity and primary closure.* In some cases of osteomyelitis there will be an intramedullary bone abscess which cannot spontaneously drain to the surface of the limb. In such cases penicillin may seem ineffectual because the blood stream in which it is carried does not reach the walled-off abscess. Often in these circumstances the patient has great pain owing to the amount of local swelling of the abscess under the periosteum. The infection may be observed to spread to the cortex of the bone and up and down the marrow cavity for its entire length. In children an abscess may form in the metaphysis and invade the adjacent joint.

In such cases operation is necessary to drain the abscess cavity and break down the wall between normal tissue and the center of the abscess. This is done after a 24- to 48-hour preliminary period of chemotherapy and refrigeration. The patient is prepared and draped in the usual manner in the operating room and an incision is made down to the bone. The periosteum is elevated and drill holes are made through the cortex toward the abscess until the central cavity, identified by pus exuding from the hole when the drill is removed, is located. The roof of the abscess is then removed completely with a rongeur or gouge and mallet. The interior of the abscess is thoroughly curetted and irrigated with copious quantities of penicillin solution containing 500 or 1,000 units per cc. The wall of the abscess cavity is usually sclerotic and densely calcified. With an electric bone drill, multiple holes are made in the base, both sides, and the top and the bottom of the abscess cavity until it resembles a sieve. In this way channels are opened up both for drainage and for invasion of granulation tissue and capillaries from the adjacent normal tissue into the center of the former abscess cavity. The wound is again irrigated with penicillin solution and the soft tissue brought together; as much of the abscess cavity as possible is obliterated by turning in muscle and soft tissue during the closure. Fine chromic catgut interrupted sutures are used for closing the wound in layers without tension. The skin is closed with a continuous cotton or dermal lockstitch and a padded pressure dressing is applied.

The patient is returned to the ward and ice bags are placed over the dressings on the limb and above the operative site. Refrigeration is continued for approximately five days and penicillin for seven to ten days. At the end of this time the wound is usually well healed and the temperature is normal. The sutures then can be removed and the patient can be permitted to walk with crutches without full weight bearing. Roentgenograms are made at monthly intervals, and weight bearing is permitted when the bone appears sufficiently healed and strong.

In the past four years in the Riverside Community and Riverside County hospitals, nine cases of chronic osteomyelitis have been treated by this method. The youngest patient was four years of age, the oldest 90. Four were women and five were boys and men. The duration of the infection before treatment varied from two to eighteen years; the average was four years. Three patients had infection of the femur, and the others had, respectively, infection of the humerus, ulna, tibia, metatarsal, phalangeal toe and ankle bone. On admission to the hospital they had temperatures varying from 101° to 106° F.; the average was about 103° F. In those cases in which operation was done, it was carried out on the second to fifth day after admission, and penicillin and refrigeration were used both preoperatively and postoperatively. In three cases operation was not necessary; the lesions healed with rest, chemotherapy, and refrigeration. In one case healing followed incision and drainage of the abscess. Open surgical procedures, with unroofing of the abscess cavity, were carried out in five cases. In one case a sequestrum was removed. Multiple drilling of the bone with "sieve" technique was done in three cases. Primary closure was done in all cases, and in all there was healing without recurrence of symptoms.⁴ None of the patients died. The average hospitalization was 14 days. One patient was given sulfadiazine as well as penicillin, as recommended by Matthews and Hutter.⁷ The others received penicillin only, averaging 300,000 to 400,000 units a day for ten days. The average total amount of penicillin given was 3,600,000 units. Refrigeration was used in all cases. The length of time it was continued ranged from four days to 11 days; the average was seven days. All the patients were followed for at least two years and none had recurrence within that time.

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